Claims

1. A process for the preparation of an acrylic acid ester polymer, comprising polymerizing an acrylic acid ester in the presence of an organolithium compound and an organoaluminum compound represented by the following formula (I):

$AlR^1R^2R^3$ (I)

wherein

R^1 represents a substituted or unsubstituted alkyl group having at least 3 carbon atoms, a substituted or unsubstituted alkoxy group having at least 3 carbon atoms or a substituted or unsubstituted aryloxy group,

R^2 and R^3 each independently represent a substituted or unsubstituted aryloxy group, or together form a substituted or unsubstituted arylenedioxy group.

2. A process according to claim 1, wherein R^1 represents a branched C_{3-12} alkyl group.

3. A process according to claim 1, R^1 represents a linear C_{4-12} alkyl group.

4. A process according to claim 1, wherein the organoaluminum compound is at least one compound selected from the group consisting of isobutylbis(2,6-di-t-butyl-4-methylphenoxy)aluminum, isobutylbis(2,6-di-t-butylphenoxy)aluminum, isobutyl(2,2'-methylenebis(4-methy-6-t-butylphenoxy))aluminum, n-octylbis(2,6-di-t-butyl-4-methylphenoxy)aluminum, n-octylbis(2,6-di-t-butylphenoxy)aluminum, n-octyl(2,2'-methylenebis(4-methyl-6-t-butylphenoxy))aluminum, tris(2,6-di-t-butyl-4-methylphenoxy)aluminum and tris(2,6-diphenylphenoxy)aluminum.

5. A process according to claim 1, wherein the acrylic acid ester is a primary alkyl acrylate.

6. A process according to claim 1, wherein the polymerizing comprises:

contacting the organolithium compound with the organoaluminum compound, and then, contacting with the acrylic acid ester, or

contacting the organolithium compound with a portion of the organoaluminum compound, and then contacting with a mixture comprising the acrylic acid ester and the remaining portion of the organoaluminum compound.

7. A process according to claim 1, wherein the polymerizing comprises feeding the acrylic acid ester during the polymerization.

8. A process according to claim 1, wherein a first amount of the acrylic acid ester is polymerized to form a living polymer thereof and, after calculating a second amount of the acrylic acid ester to be added, based on the molecular weight and the number of moles of the living polymer and the molecular weight of a final target polymer, said second amount of the acrylic acid ester is polymerized with said living polymer.

9. A process according to claim 1, further comprising, after the polymerizing, removing metal components contained in the acrylic acid ester polymer by washing the acrylic acid ester polymer with an aqueous acidic solution.

10. A process for the preparation of a block copolymer having at least one polymer block (A) comprising a polymerized acrylic acid ester (a) and at least one polymer block (B) comprising another polymerized acrylic or polymerized methacrylic monomer (b) having a chemical structure different from said acrylic acid ester (a), comprising:

polymerizing said acrylic acid ester (a) and said monomer (b) in the presence of an organolithium compound and an organoaluminum compound represented by the following formula (I):

$$AlR^1R^2R^3 \qquad (I)$$

wherein

R^1 represents a substituted or unsubstituted alkyl group having at least 3 carbon atoms, a substituted or unsubstituted alkoxy group having at least 3 carbon atoms or a substituted or unsubstituted aryloxy group,

R^2 and R^3 each independently represent a substituted or unsubstituted aryloxy group, or together form a substituted or unsubstituted arylenedioxy group.

11. A process according to claim 10, wherein R^1 represents a branched C_{3-12} alkyl group.

12. A process according to claim 10, wherein R^1 represents a linear C_{4-12} alkyl group.

13. A process according to claim 10, wherein the polymerizing comprises adding the acrylic acid ester (a) and the monomer (b) successively, simultaneously or both successively and simultaneously.

14. A process according to claim 10, wherein the polymerizing comprises contacting the organolithium compound with the organoaluminum compound and then with the acrylic acid ester (a), the monomer (b) or both the acrylic acid ester (a) and the monomer (b); or

contacting the organolithium compound with a portion of the organoaluminum compound and then with a mixture comprising the acrylic acid ester (a), the monomer (b) or both the acrylic acid ester (a) and the monomer (b), and the remaining portion of the organoaluminum compound.

15. A process according to claim 10, wherein the acrylic acid ester (a) is a primary alkyl acrylate.

16. A process according to claim 10, wherein the organoaluminum compound is at least one compound selected from the group consisting of isobutylbis(2,6-di-t-butyl-4-methylphenoxy)aluminum, isobutylbis(2,6-di-t-butylphenoxy)aluminum, isobutyl(2,2'-methylenebis(4-methyl-6-t-butylphenoxy))aluminum, n-octylbis(2,6-di-t-butyl-4-methylphenoxy)aluminum, n-octylbis(2,6-di-t-butylphenoxy)aluminum, n-octyl(2,2'-methylenebis(4-methyl-6-t-butylphenoxy))aluminum, tris(2,6-di-t-butyl-4-methylphenoxy)aluminum and tris(2,6-diphenylphenoxy)aluminum.

17. A process according to claim 10, further comprising, after the polymerizing, removing metal components contained in the polymer by washing the polymer with an aqueous acidic solution.

18. A block copolymer, comprising at least one polymer block (A) comprising a polymerized acrylic acid ester (a) and at least one polymer block (B) comprising another polymerized acrylic or polymerized methacrylic monomer (b) having a chemical structure different from said acrylic acid ester (a), wherein said block copolymer exhibits an endothermic peak during heating in differential scanning calorimetry.

19. A block copolymer according to claim 18, comprising at least one said polymer block (A) and at least two said polymer blocks (B).

20. A block copolymer, comprising at least one polymer block (A) comprising an polymerized acrylic acid ester (a) and at least one polymer block (B) comprising another polymerized acrylic or methacrylic monomer (b) having a chemical structure different from said acrylic acid ester (a), wherein said polymer block (A) has a stereoregularity of 35% or greater in terms of a content of syndiotactic triads (rr).

21. A block copolymer according to claim 20, comprising at least one said polymer block (A) and at least two said polymer blocks (B).

22. A process according to claim 1, further comprising isolating said acrylic acid polymer.

23. A process according to claim 5, further comprising isolating said acrylic acid polymer.

24. A process according to claim 9, further comprising isolating said acrylic acid polymer.

25. A process according to claim 22, further comprising molding said acrylic acid polymer.

26. A process according to claim 23, further comprising molding said acrylic acid polymer.

27. A process according to claim 24, further comprising molding said acrylic acid polymer.

28. A process according to claim 10, further comprising isolating said block copolymer.

29. A process according to claim 15, further comprising isolating said block copolymer.

30. A process according to claim 17, further comprising isolating said block copolymer.

31. A process according to claim 28, further comprising molding said block copolymer.

32. A process according to claim 29, further comprising molding said block copolymer.

33. A process according to claim 30, further comprising molding said block copolymer.

34. The product produced by the process of claim 10, wherein said product has crystalizability.

35. The product produced by the process of claim 15, wherein said product has crystalizability.

36. The product produced by the process of claim 17, wherein said product has crystalizability.

37. The product produced by the process of claim 10, wherein said product has a stereoregularity of 35% or greater in terms of a content of syndiotactic triads (rr).

38. The product produced by the process of claim 15, wherein said product has a stereoregularity of 35% or greater in terms of a content of syndiotactic triads (rr).

39. The product produced by the process of claim 17, wherein said product has a stereoregularity of 35% or greater in terms of a content of syndiotactic triads (rr).